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ABSTRACT

The goals of this research were to: (1) develop instruments useful in profiling the characteristics of teaching manuals used with grade 4 science textbooks and the effects of those manuals on teacher and pupil activities; (2) look at both high and low inference perspectives in making these profiles; (3) develop two instruments, one for elementary classroom teachers and the other for their pupils; and (4) use samples from these science education populations plus the judgments of science education professionals to profile two commonly used science teacher's manuals. Teaching manuals were analyzed because they are thought to be especially influential in elementary classrooms where reading is still not a fully developed skill. Since they are often the source for process-product/inquiry activities, teacher's manuals often play a central role in determining the quantity and quality of hands-on experiences students have. The instruments were administered to 30 fourth-grade teachers in five states who use the Silver Burdett, Merrill, or Scott Foresman text series. Seventeen teachers returned their answers as well as those of their 360 students. The graphical comparisons of teacher responses show both similarities and differences between the various teacher's manuals. Teacher and student survey forms are appended. (MVL)

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# PROFILING ELEMENTARY SCIENCE TEACHER'S MANUALS FROM DIFFERENT PERSPECTIVES

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A paper presented at the 1989 Annual Meeting of the National Association for Research in Science Teaching in San Francisco, CA, March 30- April 1, 1989.

SE 050 470

Purpose

The goals of this research were to:

1. develop instruments useful in profiling the characteristics of teaching manuals used with grade 4 science textbooks and the effects of those manuals on teacher and pupil activities,

2. look at both high and low inference perspectives in making these profiles,

3. develop two instruments, one for elementary classroom teachers and the other for their pupils,

4. use samples from these science education populations plus the judgments of science education professionals to profile two commonly used science teacher's manuals,

Etiology

The Criteria for the Analysis and Selection of Science Texts Project ( CASST Project) was initiated in 1985 to focus the efforts of science educators on the improvement of the quality of science textbooks used in American schools. As a part of their work for CASST, Good and Shymansky (1986) called for research to help establish criteria for pre-high school science textbooks. They discussed the major status of the science textbook as the primary curricular element in science education, and called for answers to two major questions:

> 1. What is the nature of the science content that should appear in science textbooks?
> 2. How should this content be presented so as to optimize comprehension by students? (p. 12)

This paper seeks to address each of these questions. It assumes that the nature of science content and the "how" of presentation are best determined by judgments and research findings of professional science educators. Their contributions to the instruments developed by this study are discussed later.

To begin their work for CASST, Good (1985) surveyed the fifty states to assess the text selection criteria used in each. Among his conclusions and recommendations from that study were the following:

1. At least two levels of appraisal forms should be developed. (A higher level form

assuming more background information for proper use and a lower form not requiring the same level of expertise.)

2. Appraisal forms should be both science content specific and directed at grade level groupings such as K-3, 4-6, etc.

3. There should be much more emphasis on problem solving in science.

4. There should be more emphasis, in the elementary grades, on lab-based development of science process skills and related knowledge of concepts.

5. Much more emphasis at the elementary grades should be placed on appraisal of teacher's manuals and supplementary materials.

Good's first recommendation, calling for both high and low inference analyses is based on the unique strengths of each type of observer. High inference observers can determine the extent to which science teaching materials meet complex goals that may be only partially seen and understood by others. Low inference analyses rely on intimate knowledge of materials content that is gained most easily from experience with the material. Good cites Howe (1985) in concluding that text appraisal instruments should combine the virtues of both high-inference and low-inference analyses. For this study, Meyer, Crummey and Greer's (1988) careful analyses of elementary teacher's manuals were used for a high inference look at these materials. Low inference items, developed by the author, were used to develop the elementary teacher and pupil instruments.

A look at current text appraisal instruments from many states, convinced Good that because of the different nature of pupils and the learning environments among the different grade levels, separate instruments should be developed to analyze various grades of instructional materials. If pupils themselves are to be a part of this analysis, as this study proposed to do, then the design of different instruments for each grade level was a necessity. Therefore for the purposes of this study, only fourth grade science teacher's manuals were examined.

Good (1985) also found from his review of the state instruments that problem solving in science and lab-based development of science process skills needed more emphasis via heavier weighting in the appraisal forms. The instruments developed for this study include a number of items assessing these issues.

Meyer, Crummey and Greer (1988) recently analyzed elementary science texts and

teaching manuals to determine their general content and attributes and to make comparisons across publishers. In the teaching manuals, they found differences in the number of lecture/discussion and hands-on activities. Their analysis concluded that Merrill had "...far more lecture/discussion activities and far fewer teacher-directed hands-on activities than Silver Burdett." Their analysis also found more activities in the Silver Burdett series. Table I shows the results of their analysis for the fourth grade teacher's manuals considered by this study. In their discussion, they suggested that science achievement needs to be considered in relation to actual teacher use of these materials as well as their contents.

TABLE I

HOW INFORMATION IS PRESENTED FROM THE TEACHER PRESENTATION BOOK AND STUDENT MATERIALS IN THE SILVER BURDETT AND MERRILL SCIENCE PROGRAMS (from Meyer, Crummey, and Greer (1988))

| Program | Grade | Number of Various Activities in Teacher's Editions | |
|---|---|---|---|
| | | Lecture/ Discussion | Hands-On Activities |
| Silver Burdett | 4 | 72 | 16 |
| Merrill | 4 | 82 | 2 |

The study reported here sought to address these highly influential teacher's manuals which accompany most elementary science texts because they are thought to be especially influential in elementary classrooms where reading is still not a fully developed skill. Good and Shymansky (1986) make the point that with the importance science educators give to process-product/inquiry, ancillary materials, which are often the source for such activities, can play a central role in determining the quantity and quality of "hands-on" experiences

students have.

Instrument Development

Based on Good's 1985 report and on work at the Center for the Study of Reading, Champagne, Illinois, Jane Armstrong, one of the CASST Advisory Board members, developed a set of criteria for use in evaluating science textbooks. She suggested analysis be done in the areas of instructional design and organization, instructional strategies, the process of inquiry, content and using science. Since her suggestions are an excellent starting place and parts of these same topics are relevant to the quality of supplementary teaching manuals, many of her suggestions were used as guidelines in developing the instruments for this study. Table II details the items in the teacher's instrument and indicates the content of each item along with the researcher upon whose work the content was based. For example, Mayer's name next to items #10 and #15 shows his work to be the source for those content ideas. Other science educator researchers are identified in Table II and a relevant, if any, publication is cited.

TABLE II

Analysis of Instruments by Content Origin and Inference Level

| Content Category | Content Origin | Teacher's Instrument | | | Addressed by Pupil's Instrument? |
|---|---|---|---|---|---|
| | | Item Letter | Item Number | Inference Level | |
| Inquiry/Discovery/Process | | | | | |
| Frequency of discovery | Mayer (1983) | F | 10 | Low | |
| Promote process skills? | Armstrong | D | 8 | Low | |
| Test items measure process? | Armstrong | Ma,b | 20 | Low | |
| Concrete/Hands-on | | | | | |
| Percentage of Hands-on | Armstrong | I | 13 | Low | yes |
| Familiar and concrete underpinnings suggested? | Mayer (1983) | | 15 | Low | yes |
| Quantity of activities | Bredderman (1983) | H | 12 | Low | yes |
| Common background experiences | Finley (1983) | K | 16 | Low | yes |
| Science applied to daily lives? | Armstrong | E | 9 | Low | yes |
| Reading, Vocabulary and Science | | | | | |
| Importance of Reading the text (Reading vrs. Activities) | Shymansky and Yore (1979) | Ca,b,c | 7 | Low | |

| | | | | | |
|---|---|---|---|---|---|
| Help for below-grade readers? | Shymansky and Yore (1979) | Ga,b,c,d | 11 | Low | |
| Importance of science words | Armstrong | Ma,b,c | 20 | Low | |
| <u>Helpfulness of manual</u> | | | | | |
| Bold-faced Headings | Armstrong | A | 5 | Low | |
| Accuracy of procedures | Armstrong | J | 14 | Low | |
| Suggestions actually used | Evans | B | 6 | Low | |
| Science background for teacher? | Armstrong | L | 19 | Low | |
| <u>Evaluation Suggestions</u> | | | | | |
| Evaluation ideas during chapter? | Armstrong | O | 22 | Low | |
| Does evaluation match lessons? | Armstrong | P | 23 | Low | |
| Kinds of evaluation suggestions | Armstrong | N | 21 | Low | |
| <u>Cognitive Skills</u> | | | | | |
| Promote cognitive conflict? | Posner et al (1982) | | 17 | Low | |
| Promote higher thinking skills? | Armstrong | | 18 | Low | |
| Validity of this instrument | Evans | R | 25 | High | |
| Affective | Evans | (not asked) | | | yes |

One reason this study looked at the judgments of science education professionals like Meyer, Crummey and Greer (1988) as well as at classroom teachers was to take advantage of their respective abilities to provide high and low inferential analyses of teaching materials. Classroom teachers who have just taught a chapter or unit using a teacher's manual are in an excellent position to quantify, tabulate and generally identify the characteristics of that manual. Professionals in science education are able to make complex judgments about a manual's nature which may be beyond the sophistication of the typical teacher.

The pupil perspective is also helpful in assessing the characteristics of a particular teacher's manual. If the manual encourages one sort of teacher activity and the students consistently report another, then that particular manual's ability to facilitate instructional methods would obviously be questioned. Since elementary pupils have limited abilities to respond to written questionnaires, their questionnaire contains only four items. Two seek the kinds of activities and learning the students recall from a recently completed chapter or unit. Another question assesses their feelings about the lessons (i.e. boring, interesting, too long, too short, fun, hard, etc.) and the last attempts to measure their success as science students.

The Pilot Study

A "pilot" trial of these instruments plus a parallel one developed for administration to science education professionals was conducted to: judge the value of using instruments on different populations to analyze ancillary science teaching materials; determine the extent to which the instruments coincide and complement each other in their assessments of teacher's manuals; assess the validity of the instruments from the point of view of the populations using them and to determine the practical problems in administering these instruments. Results of this pilot study were reported at the NARST meeting in Washington in 1987, Evans (1987).

A rather consistent "profile" among the teachers surveyed, showed that that instrument does provide one useful method of describing the characteristics of teacher's manuals. However, since the pilot instruments were only used with one publisher's materials it was not known if the "profiles" of other manuals would have been significantly different.

The pupil's responses, while unable to contribute large amounts of information to a teaching manual's profile, did add two important dimensions. Regardless of what classroom teachers using a manual and science educators reading it say about the kinds of science activities it promotes, a class of students independently reporting on what they actually did during a unit, is an excellent source of information about the relative success of different teaching manuals in promoting science process activities. In addition, the ability to access the affective responses of students to a particular chapter, taught with a certain teaching manual, provides an important dimension to an analysis which is difficult to obtain from any other source.

Methods

This study built upon the pilot by revising each of the instruments. New shorter versions were designed to have greater scaling uniformity, and an attempt was made to eliminate useless, redundant and non-discriminating questions. The teacher's questionnaire is included in this report as Appendix A and the pupil's as Appendix B. Last spring these new instruments were given to thirty fourth grade teachers who use the Silver Burdett, Merrill or Scott Foresman text series in North Carolina, Minnesota, Texas, Missouri and Ohio. Seventeen teachers returned their answers along with those of their 360 pupils. Teachers were asked to report on any chapter or unit they had just finished. This variety of content was encouraged both to give the resultant profiles greater validity for the entire series and to make the test for differences more

vigorous. Graphical analysis of the results as well as t-Tests on differences between various means were produced.

## Results

The means for each scoreable item on the teacher's questionnaire are presented for the five classes using the Merrill text and the twelve teachers using Silver Burdett in Figure 1. Since only one teacher and class in the sample used Scott, Foresman materials, that series is not included in this report. Most responses showed no significant differences in teacher perceptions of the two manuals. However, question Ca (#7a), which asked teachers to report how activity or reading oriented they thought the first teaching suggestion in their manual was, found Silver Burdett significantly (at the .02 level) more activity oriented than Merrill. Questions Ga and Gd (#11a and 11d) found that the Silver Burdett manual gave significantly greater (at the .04 level) help to teachers in working with below-grade level readers than did the Merrill manual and, while not significant, questions Gb and Gc on the same topic were also more positive for Silver Burdett. The other significant difference was in question L(#19) which discovered a teacher perception of significantly greater (at the .04 level) background information in the Merrill manual than in Silver Burdett's.

Although not significant, question D (#8) results showed that teachers using Silver Burdett reported more science processes actually used by them in teaching than did teachers using Merrill. Another non-significant result for question F (#10) found Merrill teachers reporting more "discovery" learning activities in their manual than Silver Burdett teachers.

Figure 2 graphically compares the means for the two major pupil questions. Unpaired t-Tests for significant differences between these means are reported in Tables III and IV. The first question (see Appendix B), which asked students to name all the activities they did during the unit, found significantly more activities reported by Silver Burdett students than pupils using Merrill materials. The second question, which asked students to list all the content things they learned about, also found a significantly greater number among the students exposed to Silver Burdett. Their attitudes towards science were not significantly different.

## Discussion

Even with this small sample of teacher opinion, the profiles of the Merrill and Silver

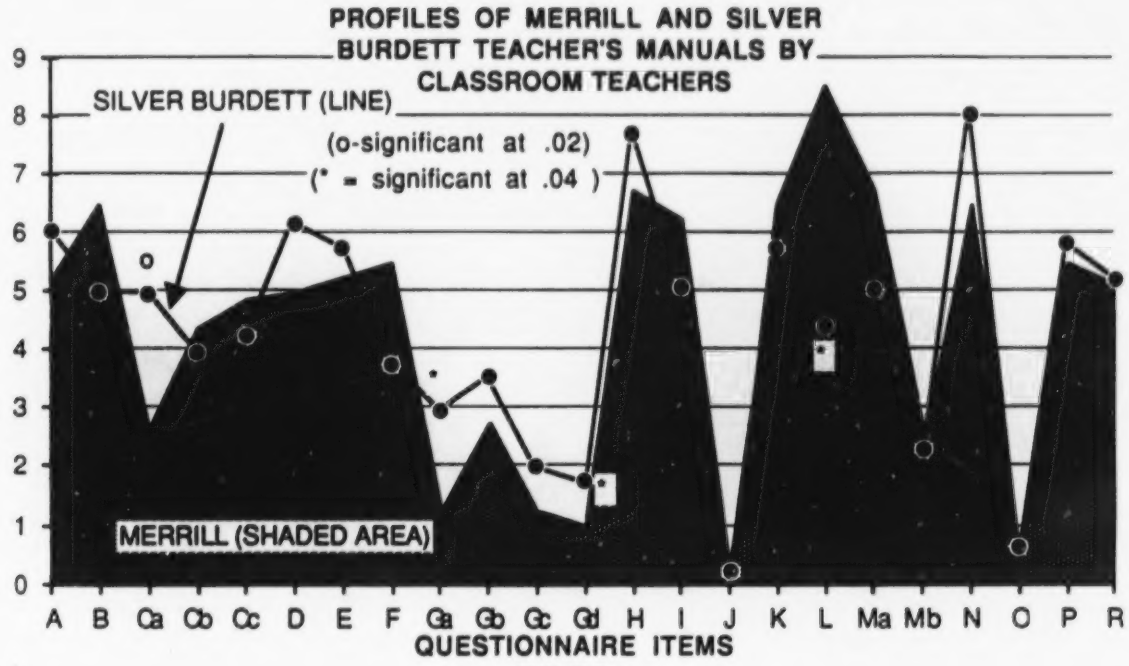
PROFILES OF MERRILL AND SILVER BURDETT TEACHER'S MANUALS BY CLASSROOM TEACHERS
SILVER BURDETT (LINE)
(o-significant at .02)
(* = significant at .04 )
MERRILL (SHADED AREA)
9
8
7
6
5
4
3
2
1
0
A B Ca Cb Cc D E F Ga Gb Gc Gd H I J K L Ma Mb N O P R
QUESTIONNAIRE ITEMS

FIGURE 1

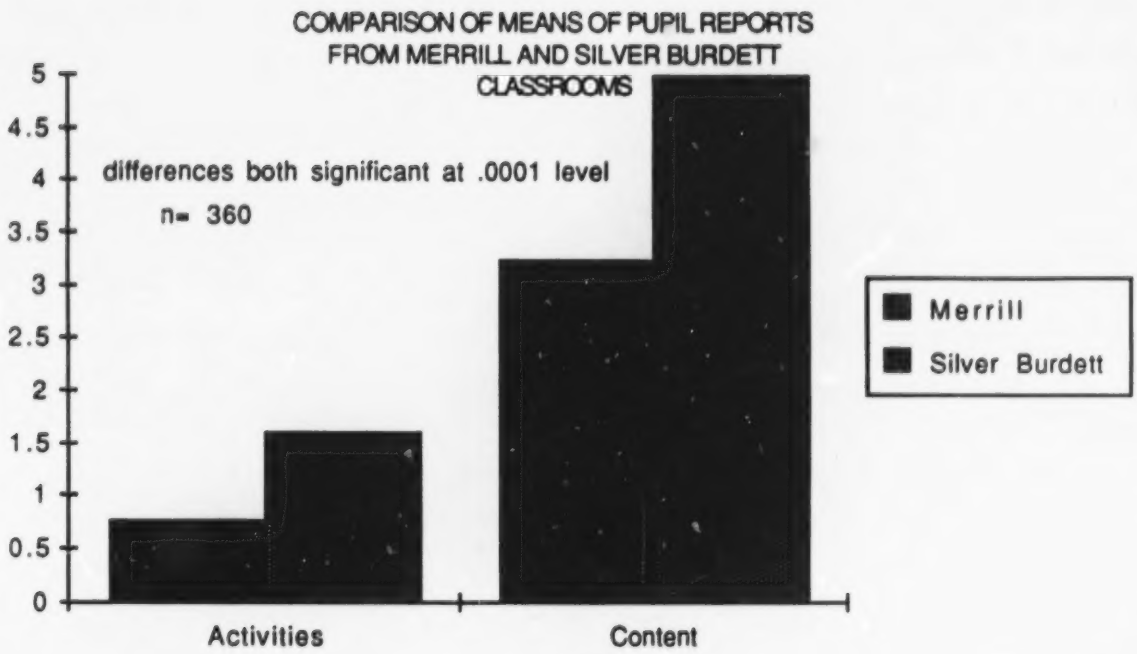
COMPARISON OF MEANS OF PUPIL REPORTS
FROM MERRILL AND SILVER BURDETT
CLASSROOMS
differences both significant at .0001 level
n= 360
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Activities
Content
Merrill
Silver Burdett

FIGURE 2

TABLE III

UNPAIRED t-TEST: SERIES MANUAL VRS. CONTENT

| DF: | Unpaired t Value: | Prob. (2-tail): |
|---|---|---|
| 359 | -3.908 | .0001 |

| Group: | Count: | Mean: | Std.Dev.: | Std. Error: |
|---|---|---|---|---|
| Merrill | 79 | 3.241 | 2.879 | .324 |
| Silver Burdett | 282 | 4.979 | 3.646 | .217 |

TABLE IV

UNPAIRED t-TEST: SERIES MANUAL VRS. ACTIVITIES

| DF: | Unpaired t Value: | Prob. (2-tail): |
|---|---|---|
| 359 | -4.646 | .0001 |

| Group: | Count: | Mean: | Std.Dev.: | Std. Error: |
|---|---|---|---|---|
| Merrill | 79 | .772 | .933 | .105 |
| Silver Burdett | 282 | 1.589 | 1.481 | .088 |

Burdett teacher's manuals show clear, and in the case of 17% of the items, significant differences. These teacher's opinions coincide with Meyer, Crummey, and Greer's (1988) findings that Silver Burdett has more hands-on activities and Merrill has more lecture/discussion suggestions. This study's teachers found the first Silver Burdett suggestions in various units to be significantly more activity rather than reading oriented. On the other hand they found that Merrill provided significantly more background information for the teacher, which can be assumed to be especially useful to teachers engaged in lecture/discussion activities. The consistently greater help with below-grade level readers which teachers found in the Silver Burdett series was not reported in the Meyer, Crummey, and Greer (1988) study. These unique profiles by teachers who have actually taught the units they are describing, can provide important insights for science educators into the perceived attributes of teacher's manuals. Are manual attributes, which are not recognized as such by teacher users, useful components or do they need to be revised?

Since the pupil reports of both significantly greater content learning and number of activities engaged in for Silver Burdett as compared to Merrill are the end results of textbook and teacher manual usage, they are especially important to science educators. This is particularly true since the Meyer, Crummey, and Greer (1988) study found more activities in the Silver Burdett teacher's manuals and this study's teachers found some evidence of at least the first manual suggestions being more activity oriented. The possibility, advocated by Good and Shymansky (1986), that teacher's manuals do indeed have an influence on the quantity of science activities is enhanced.

Further work should include a larger sampling of teachers and of the other elementary text series so that strongly representative profiles can be created for each manual. The usefulness of pupil reports should be further exploited with other questions intended to assess outcomes of series use. It would also be helpful to ask teachers more questions about their actual teaching strategies resulting from their use of the teacher manuals.

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APPENDIX A

# SURVEY OF TEACHER'S MANUALS FOR ELEMENTARY SCIENCE TEXTS

**Thank you** for agreeing to complete this questionnaire about the teacher's manual you used for a recent science chapter. Please base all of your answers on the manual suggestions for the chapter you taught, not c other chapters in the manual nor on other manuals. You'll probably need the teacher's manual for reference while filling out this questionnaire.

1. What is the name of the teacher's manual about which you're reporting?

2. Who is the publisher of this teacher's manual?

3. What date was it published?

4. What is the name of the chapter about which you're reporting?

A 5. Review the bold faced headings in the manual for the chapter you taught. When you taught this materia were you able to locate the teaching ideas and assistance you needed just by using these headings?

|_____|_____|_____|_____|_____|_____|

always sometimes never

B 6. Look through the teaching suggestions for the chapter you used in the teacher's edition. Approximately h many of the manual's suggestions for this chapter did you actually use?_____

7.List the first 3 teaching suggestions, for the chapter you're reporting on, in the spaces below. Then mark alc the answer bar how much reading is associated with each suggestion.

CA 1st Suggestion:_____

|_____|_____|_____|_____|_____|_____|

only involves reading a mixture only involves an activity

CB 2nd Suggestion:_____

|_____|_____|_____|_____|_____|_____|

only involves reading a mixture only involves an activity

CC 3rd Suggestion:_____

|_____|_____|_____|_____|_____|_____|

only involves reading a mixture only involves an activity

D 8. Now, use this list to tell which of the science processes is encouraged by the activities **you used** from th manual. Circle all that you used with children as a result of the ideas contained in this manual.

1 observing
2 experimenting
3 verifying
4 predicting
5 organizing
6 inferring
7 analyzing
8 synthesizing
9 generalizing

E 9. Count the number of times in this chapter of the teacher's manual where ideas are given for applying sci to children's everyday lives. _____

F 10. How many times does the teacher's manual suggest "discovery" learning activities where students can

basically **discover** for themselves the scientific concept under consideration? _____

11. Based on the chapter you've taught, indicate whether or not the teacher's manual provides suggestions lil the following to help below-grade level readers.

**GA**..how to rearrange topics or chapters into a sequence which is more appropriate for the students' reading

|_____|_____|_____|_____|_____|_____|

a lot some none

**GB**..how to use conceptually similar material from other sources that is more appropriate to the students' reading level

|_____|_____|_____|_____|_____|_____|

a lot some none

**GC**..how to develop study guides for difficult reading sections

|_____|_____|_____|_____|_____|_____|

a lot some none

**GD**..how to make verbal tapes of difficult reading material for less able readers

|_____|_____|_____|_____|_____|_____|

a lot some none

H 12. How many different <u>activities</u> for students are suggested for the chapter you taught using the teacher's manual?_____

I 13. From all the suggestions given, what percentage are for <u>hands-on activities</u> for students?

|_____|_____|_____|_____|_____|

0% 20% 40% 60% 80% 100%

J 14. From the suggestions for this chapter, recall the apparent inaccuracies in either content or in the step-by-step procedures. How many instances did you find in this one chapter? _____

15. Find an instance where the teacher's manual gives a suggestion for providing students with familiar and concrete underpinnings of scientific ideas <u>before introducing new ideas</u>. (For example, if you were studying energy, the manual might suggest that you have your students rub their hands together until they are warm.) Describe that suggestion briefly.....

_____

_____

_____

How many times does the manual provide suggestions like the one you've described, in the chapter you taught?_____

K 16. Check the manual to see whether common classroom <u>background experiences</u> are suggested for stud do BEFORE they are asked to read a textual passage. What percentage of lessons provide this common exp

|_____|_____|_____|_____|_____|

0% 20% 40% 60% 80% 100%

17. How many activities suggested by the teacher's manual promote cognitive conflict in the students. That is how many activities reveal something about the world that goes against what the students think **before** they c the activity?_____

18. Look at the **enrichment** suggestions for the unit or chapter you are reporting on and tally each activity int one of the following categories:

_____lower level thinking called for (knowledge, understanding)

_____higher level thinking needed (analyzing, synthesizing, evaluating)

L 19. How many paragraphs of background information does this chapter of the teacher's manual provide for teacher?_____

20. Review all the evaluation questions suggested by the teacher's manual. Estimate the percent which are devoted to measuring each of the following:

**MA** learning scientific vocabulary

|_____|_____|_____|_____|_____|

0% 20% 40% 60% 80% 100%

**MB** learning from hands-on activities

|_____|_____|_____|_____|_____|

0% 20% 40% 60% 80% 100%

learning scientific concepts

|_____|_____|_____|_____|_____|

0% 20% 40% 60% 80% 100%

N 21. Circle each of the following evaluation methods suggested by the teacher's manual for your selected chapter:

a. knowledge test questions
b. comprehension test questions
c. questions requiring students to apply knowledge
d. higher-level test questions
e. student-self tests
f. tests involving manipulation of objects
g. multiple-choice questions
h. true and false questions
i. short answer questions
j. matching questions
k. paragraph essay questions
l. fill-in-the-blank questions
m. questions with drawings
n. questions using mathematics

O 22. Does the teacher's manual provide suggestions for evaluating student progress **during** the chapter as as at the end?_____

P 23. To what extent do the evaluation questions match the science information covered in this Chapter? Tha are the questions about exactly the same science ideas covered and in the same amount?

|_____|_____|_____|_____|_____|_____|

exactly somewhat not at all

24. Finally, counting the current year, how many years have you taught school?_____

R 25. To what extent do you think this questionnaire allowed you to tell us about the contents of the teacher's manual?

|_____|_____|_____|_____|_____|

completely partially hardly at all

**THANKS AGAIN FOR YOUR TIME AND PROFESSIONAL ASSISTANCE!**

Please use the stamped manila envelope
to return this questionnaire and your
student's questionnaires to:

Robert H. Evans
Education Department
Wake Forest University
Winston-Salem, N.C. 27109

APPENDIX B

**Write a letter to your friend telling them everything you've done in science with _____ recently.**

**(Your teacher will tell you the science subject to write about.)**

***Dear _____,***

***I've done all of these things in science while we studied about _____:***

**Please turn this paper over and do the other side.**

**Tell your friend about studying _____.**
**Circle the words below which tell what it was like.**

**boring interesting good bad fun hard**
**too long too short just about right**

**Your friend wants to know the most important things you learned while studying _____. Write them below.**

***The most important things I learned were....***

**Did your teacher give you a test or quiz on _____?**
**Yes or No If "yes", how did you do? (circle one answer)**

**very well pretty good OK not very good very poorly**